



## **Syllabus for ES234: Air Pollution and Resources**

Fall 2017

Instructor: Wolfgang Rogge, Ph.D., P.E.

**Designation:** ES234

**Credit:** 3 Credits

**Catalog Description:** Atmospheric sciences and meteorology; chemistry of air pollutants and its fate; gas-to-particle conversion; nucleation and coagulation of aerosol; oxidizing power of the troposphere; ozone pollution; wet and dry pollutants deposition; air quality modeling; global climate change; impact on human health and natural environment.

**Text Books:** (1) INTRODUCTION TO ATMOSPHERIC CHEMISTRY by Daniel J. Jacob, published by Princeton University Press Princeton, New Jersey, 1999.

(2) AIR POLLUTION AND GLOBAL WARMING Mark Z. Jacobson  
Second Edition Cambridge Press ISBN 978-1-107-69115-5

(3) Handouts and Notes

### **Course Objectives:**

1) To provide students with substantial science and engineering knowledge necessary to understand air pollution formation, release, transformation, dispersion, and potential health impacts; 2) to demonstrate how that knowledge together with mathematics and modeling tools are applied to solve air pollution problems; and 3) to enable the students to formulate problems and subsequently design solutions to air pollution problems using assumptions based on scientific and engineering methods and tools.

### **Student Learning Outcomes:**

Considering local and global air pollution problems and national requirements as well as international agreements on pollution control, students will be able to determine necessary emission reductions to prevent harm to occur to human health, welfare, the natural environment, and climate. By the end of the course through lectures, problem

solving in supervised class meetings, homeworks, readings, presentations, and exams:

- The students will have demonstrated skills to formulate and solve often complex air pollution problems, understand the potentially different chemical avenues alternative chemical pollutants will take. Be able to vary study outcomes by varying assumptions to complex atmospheric chemistry issues.
- Students will be able to develop and apply mathematical models to predict the atmospheric chemical transformation of pollutants as well as horizontal and vertical transport throughout the troposphere and stratosphere and exchange between the hemispheres.
- Students will become proficient to process, analyze, and interpret air pollution and meteorological data and to apply scientific methods and environmental science and engineering strategies that help to promote a more sustainable and healthy environment.
- Further, they will be able to discuss knowledge gaps that require more advanced studying and the need for additional future research. Their communication skills will improve through discussions and presentations.
- Additional proficiency will be obtained by a state-of-the-art individual semester long project that covers problem(s), assumption(s), and solution(s) to a current air pollution issue; and, they will obtain an appreciation for the complexity and importance of air pollution problem solving.

The aforementioned student learning outcomes relate to the first three program learning outcomes listed below.

### **Program Learning Outcomes:**

The overarching goal of the Environmental Systems program is that its graduates be knowledgeable and professionally competent in one or more areas of environmental systems. The following program learning outcomes are being used to attain this goal:

- **Core Knowledge** - Graduates will be knowledgeable, skillful and self-directed in the observation and analysis of environments systems in terms of their capacity to independently identify important research questions, formulate experimental plans, data analysis and formulation of conclusions in the context of a doctoral dissertation.
- **Communication Skills** - Graduates will be conversant in at least two areas of environmental systems, and be adept at oral, written and visual communication of research results to peers and non-technical decision makers.
- **Ethics, Community, and Life-long Learning** - Graduates will understand the importance of research and professional ethics, engagement in the needs of their community and life-long learning.
- **Career Placement and Advancement** - Graduates will find suitable career placement and achieve advancement in government agencies, non-government organizations, private industry, and/or academic teaching and research institutions.

**Prerequisites by Topic:** EnvE20 or permission of instructor

**Course Policies:**

- a) Course setup: There will be traditional lectures based on book (1) INTRODUCTION TO ATMOSPHERIC CHEMISTRY by Daniel Jacob. Because the chapter on aerosol is rather limited, additional material will be provided to substantially extend the knowledge on atmospheric aerosol. Additionally, further material will be provided on filtration of particulate matter as well as air pollution dispersion modeling.
- b) Attendance and Participation: required
- c) Readings: Our textbooks are mostly excellent. For the success of interactive learning and problem solving, it is paramount that you come to class prepared and ready to ask questions on whatever you might not have understood in the book chapter. Even if not explicitly advised, you are responsible to read ahead so that you are prepared for the next class meeting. There will be an online multiple-choice quiz for each section (AIR POLLUTION AND GLOBAL WARMING Mark Z. Jacobson) assigned as student presentation. So, each student is required to read the respective section and take the online multiple-choice test before coming to class.
- d) Assignments: Homework assignments will consist of 6 to 10 problems each and are due on set day. Your homework will be graded through Cat Courses, multiple choice questions will be asked about each homework problem and if selected correctly, you will receive your points. Nonetheless, to satisfy ABET, you have to upload pdf files of your homeworks. Naturally, late homework will not be accepted, receiving zero points, unless you can provide evidence that you were sick or had other problems that drastically interfered with finishing your homework. Working with other students on the homework in teams can be very helpful. Begin your homework as soon as it is assigned. The solution to the homework will be posted on CatCourses after all homeworks are obtained Please do not hesitate to ask me if you feel that you do not understand the solution. Each problem should be exactly labeled with the number used in the book, problem stated, approach to solve problem shortly summarized, and all partial and/or final results clearly labeled.
- e) Presentations: Furthermore, two sets of 4 students are asked to prepare a 12-15 min presentation (PowerPoint) for each meeting about a section/chapter in book (2) AIR POLLUTION AND GLOBAL WARMING by Mark Z. Jacobson, see schedule provided separately. During each meeting we will have two presentations from two sections in the book. Randomly, one student for each of the two sections will be selected to present each a talk, followed by discussion. All presentations have to be uploaded as PowerPoints to CatCourses by 8am the day of presentation. I will then select from each group one student and show the PowerPoints during our Zoom meeting. I will communicate by 9am or so who the lucky winners are for the day! Do prepare your presentation well! All students are required to upload their PowerPoint presentation to CatCourses and will obtain points for the quality of the

PowerPoint presentation (each student) and for the oral presentation (presenting student only). At least one day (24h) before each class, there will be a multiple-choice test available through CatCourses that has to be taken online. Each test will cover the section/chapter assigned for presentations for a given date. All students have to take the online tests. The tests are timed and can only be taken one time! So, be ready to take the test before you sign on! For learning purposes and continuous learning "old questions" from prior tests, may be asked again. So, if you know that you answered a question wrong, please revisit the book and learn the respective material.

- f) Web Site: PowerPoint presentations, homework assignments and solutions as well as important announcements (deadline changes, exam dates, etc.) will be posted on the course web site. It is important that you get comfortable with using this system early in the semester.
- g) Cell phones: Please turn down cell phones and pagers before the zoom meeting starts.

### **Disability Statement:**

Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

### **Topics:**

- Measures of Atmospheric Composition
- Atmospheric Pressure
- Simple Atmospheric Models, determining Global Concentrations
- Atmospheric Transport
- Air Pollution in Cities
- Aerosols, formation & conversion dynamics, health impact, physics of viruses and bacteria
- Filtration of small particulate matter
- The Greenhouse Effect
- Chemical Kinetics
- Oxidizing Power of The Troposphere
- Ozone Air Pollution
- Air Pollution Dispersion Modeling

**Class/laboratory Schedule:** MW 11:30 - 13:20, CLSSRM 263

**Exams Schedule:****Online Tests and In-class Exams Schedule:**

There will be an online multiple-choice quiz for each scheduled day (AIR POLLUTION AND GLOBAL WARMING Mark Z. Jacobson) of the two presentations. So, all students of this course are required to read the respective sections and take the online multiple-choice test before coming to class. This online test is open for at least for 24 hours (from noon to noon). Each of these multiple-choice tests can only be taken one time and when an answer is selected, this cannot be changed anymore.

**Midterm:** Will be a "group take-home" exam. At least two students and not more than three students have to work as a group on the midterm. Per group, only one midterm exam is allowed to be handed in on set date. No one-student (individual) midterm exam will be accepted! Start early to assemble a team! There will be one week to solve the exam. The midterm exam has to be typed. No handwritten exam will be accepted! This exam is long; therefore, meet with your group frequently and develop a group work and assignment plan early on.

**Final Exam:** Will be a "group take-home" exam. At least two students and not more than three students have to work as a group on the exam. Per group, only one exam is allowed to be handed in on set date. No one-student (individual) midterm exam will be accepted! Start early to assemble a team! There will be one week to solve the exam and it is due at the last day of class. The exam has to be typed. No handwritten exam will be accepted! This exam is shorter than the midterm; but, nonetheless, meet with your group frequently and develop a group work and assignment plan early on.

**Assessment/Grading Policy:**

Chapter Presentations (Mark Z. Jacobson's Book): 15%;  
Online multiple-choice tests: 20%;  
Mid-term exam: 25%;  
Final exam: 25%;  
Homework: 15%.

**Coordinator:** Prof. Wolfgang Rogge, Ph.D., P.E.

**Contact Information:**

- CatCourses
- wrogge@ucmerced.edu

*I prefer being contacted by email. Simply, I can respond to you with my iPhone even when away from my desk and not having access to CatCourses.*

**Office Hours:** Mon & Wed: 13:30-15:00; or by appointment.

**Office:** SE2-380